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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/006,578	12/06/2001	Manoj K. Jain	TI-31858	4968
23494	7590	02/19/2004	EXAMINER	
TEXAS INSTRUMENTS INCORPORATED P O BOX 655474, M/S 3999 DALLAS, TX 75265			LE, THAO X	
			ART UNIT	PAPER NUMBER
			2814	

DATE MAILED: 02/19/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/006,578	Applicant(s) JAIN, MANOJ K.	
	Examiner Thao X Le	Art Unit 2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
 - If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
 - If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
 - Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 December 2003.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,4-9 and 11-16 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,4-9 and 11-16 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1, 4-9, 11-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent 6291340 to Sandhu et al. in view of US 6436819 to Zhang et al.

Regarding to claims 1, 4, Sandhu discloses a method of forming a conductive structure in an integrated circuit in Fig. 1, comprising the steps of: forming a dielectric layer 32, column 6 line 57, over a semiconductor body, forming a hole 31, column 6 line 65, fig. 3, in dielectric layer 32, forming a conductive liner 35, column 7 line 1, in hole 31, annealing conductive liner, column 7 lines 16-22, forming a conductive barrier 41, column 7 line 13, fig. 4, filling hole 131 with a conductive material 62, column 7 line 30.

But, Sandhu does not expressly disclose after annealing conductive liner, treating conductive liner with plasma hydrogen.

However, Zhang reference discloses in fig. 8a-f a method wherein the conductive liner 806 is being treated with plasma 850 comprises hydrogen, column 11 lines 42-45.

At the time the invention was made; it would have been obvious to one of ordinary skill in the art to combine the method of treating conductive liner with hydrogen of Zhang with Sandhu's method, because such hydrogen treatment would have improved the

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metal/nitride stack film properties, including enhanced adhesion and barrier characteristics as taught by Zhang, see abstract.

Regarding to claims 5-7, 12-15, Sandhu does not disclose the hydrogen containing atmosphere comprises pure hydrogen or hydrogen mixed with a carrier gas.

But, Zhang reference discloses Zhang discloses different combinations of plasma gas, including N₂, H₂, NH₃, column 9 lines 57-59. It would have been obvious to one of ordinary skill in art to use teaching Zhang as claimed, because it would have produced the same results as discussed in the above claim 1. In addition, it has been held that where the general conditions of the claims are discloses in the prior art, it is not inventive to discover the optimum or workable range by routine experimentation. See *In re Aller*, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955).

Regarding claims 8, 16, Sandhu does not discloses the method further comprising the step of repeating treating step prior to filling step.

But Zhang reference discloses the method further comprising the step of repeating treating step 852, fig. 8c, prior to filling step. At the time the invention was made; it would have been obvious to one of ordinary skill in the art to combine the method of treating conductive liner with hydrogen of Zhang with Sandhu's method, because such hydrogen treatment would have improved the metal/nitride stack film properties, including enhanced adhesion and barrier characteristics as taught by Zhang, see abstract.

Regarding to claims 9, 11, Sandhu discloses a method for forming a contact in an integrated circuit, comprising the steps of: forming a dielectric layer 32, column 6 line 57, over a semiconductor body, etching a contact hole 31, column 6 line 65, fig. 3, extending through

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dielectric layer 32, deposited titanium 35, column 7 line 1, in hole 31, over dielectric layer, including on exposed surface with contact hole, annealing titanium, column 7 lines 16-22, deposit TiN 41, column 7 line 13, fig. 4, over titanium, and then filling contact hole 131 with a tungsten 62, column 7 line 30.

But Sandhu does not expressly disclose the method comprising treating titanium with hydrogen prior to annealing step.

However, Zhang reference discloses the method comprising treating titanium with hydrogen. Zhang reference has demonstrated that the treating conductive liner with hydrogen at different stage of the process, fig. 5a-5e, 7a-7d, and 8a-8f has produced the same effects. At the time the invention was made; it would have been obvious to one of ordinary skill in the art to combine the method of treating conductive liner with hydrogen of Zhang with Sandhu's method prior to annealing titanium, because such hydrogen treatment would have improved the metal/nitride stack film properties, including enhanced adhesion and barrier characteristics as taught by Zhang, see abstract.

Response to Arguments

3. Applicant's arguments filed on 04/30/03 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

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4. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

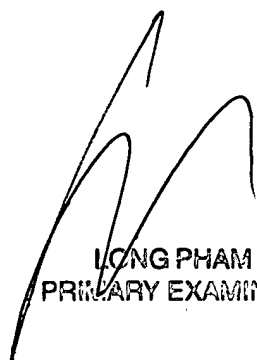
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thao X Le whose telephone number is (571) 272-1708. The examiner can normally be reached on M-F from 8:00 AM - 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael M Fahmy can be reached on (571) 272 -1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Thao X. Le
10 Feb. 2004



LONG PHAM
PRIMARY EXAMINER